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Application of the Index of Connectivity in a Chilean catchment affected by volcanic eruption

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The balance of energy, water, and sediment fluxes exerts control over forms and processes of the landscape, and it can be continuously affected by natural and/or anthropic disturbances. Large disturbances, such as volcanic eruptions, are able to disrupt the links among different compartments of the system in which the fluxes take place. Recently, sediment connectivity indices represent powerful tools to assess the potential sediment behavior in post-disturbance scenarios, according to the structural properties of the geomorphic system itself.
The objective of the present research is to adapt and apply the Index of Connectivity in a catchment affected by an explosive volcanic eruption, using a combination of field surveys and image classification techniques. Moreover, a multi-temporal analysis, which relies upon open source data, was carried out. The area of interest is located in southern Chile, where the Blanco River catchment suffered from the eruption of the nearby Chaitén volcano (2008-2009). The river network was completely filled by a huge amount of sediments, causing the entire floodplain's burial of several meters and the sudden widening of the active channel. Along the river corridor, as well as on the slopes, the old-native vegetation was removed or largely damaged. Due to the multitude of factors involved, the analysis of connectivity index was outlined through a workflow aimed at deriving a land cover-based weighting factor, representing the impedance to the sediment fluxes. A compound of field observations and satellite image classification techniques was used to implement the weighting factor derived from the Manning's n coefficient for the overland flow. The base Digital Elevation Model (DEM) with a resolution of 12.5 m is freely available on the web, as well as the Landsat images used (period 1999-2017) to derive the weighting factor. The results showed a general increase of IC values throughout the catchment after the eruption mainly related to the removal of vegetation, which facilitates the transfer of sediment fluxes. In addition, due to the widening of the active channel, the sediment source areas became more connected to the channel network. Finally, the combination of the land cover changes and active channel expansion promoted the increase of IC values all over the Blanco River catchment. The use of satellite image classification along with field observations helped the spatial characterization of structural connectivity in the densely vegetated study area. Nonetheless, further improvements to involve also the functional connectivity can not be neglected, especially in such complex environment.